Exotica at STAR

Hank Crawford
(Dave Hardtke)

Remnants of the Plasma State

Assume force is sufficient to tear apart nucleons

10^{32} g's

Form highly excited states with no quantum numbers

Or form sea of q, qbar, gluon points

Every possible state will form
- some only possible from QGP

What footprints will they leave?

Rare Signals

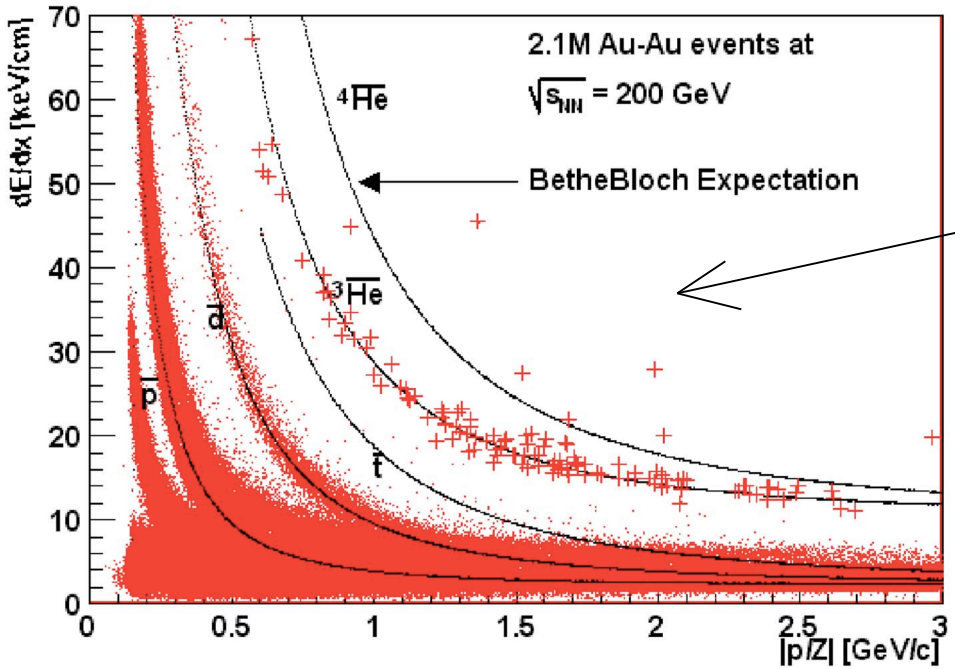
- Anti-alphas and beyond
- Anti-Hypernuclei
- Strangelets
- Dibaryons H and □□
- Glueballs/hybrids
- □□' mesons
-

Searching fringes of detector response space

Note that QGP footprints need not be rare.

Struck Abar Analysis

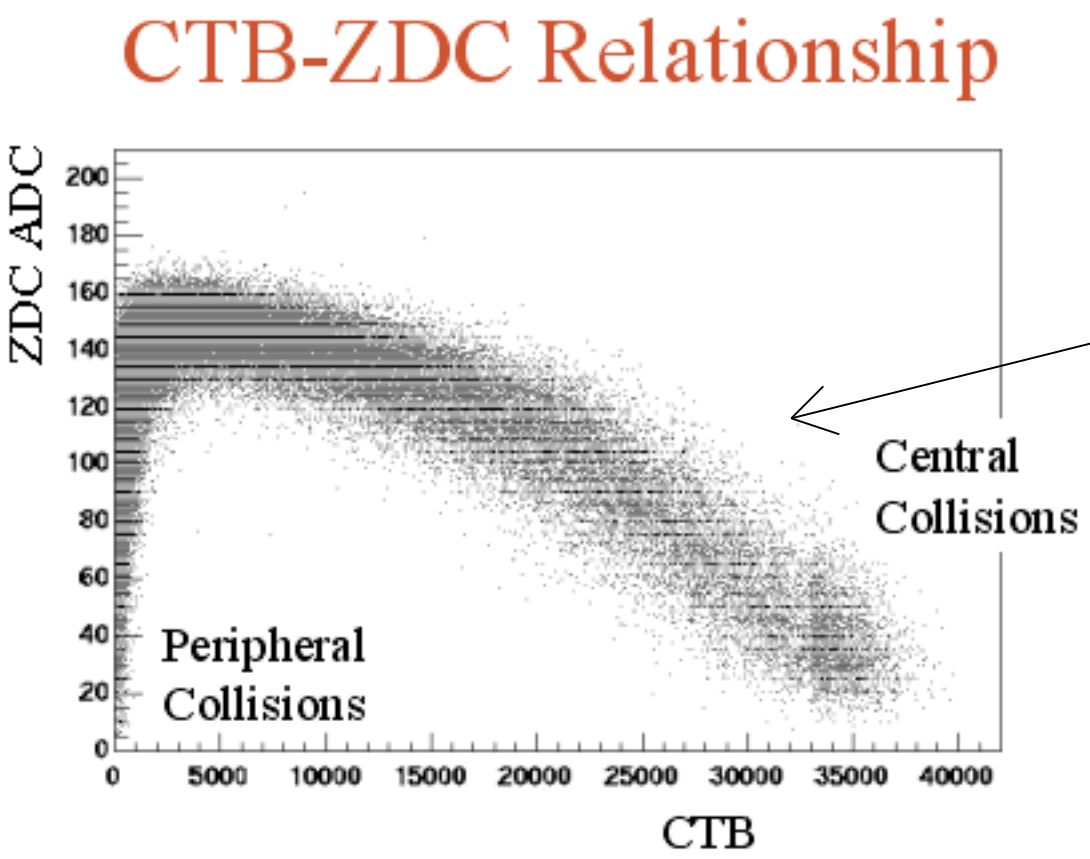
20 □bar / 50M central AuAu



Search here

Search 3Hebar candidates
For $tbar_{□bar}$-> 3Hebar + π^+
signature

Strangelets - Smoking Gun



${}_{s}A^{Z}$ u~d~s

Zhangbu says
"Search here"

DiBaryons

Boris looking hard

□□ -> H (uuddss)

□□ - > ?? (ssssss)

Huan says "check it out"

Requires soup of low relative velocity hyperons

Using the HI environment to probe nucleon-nucleon and spin forces

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Suggesting a di-omega dibaryon search in heavy ion collision experiments

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(Received 15 October 1999; published 18 May 2000)

The structure of a new dibaryon $(\Omega\Omega)_{0^+}$ is studied theoretically in the framework of the chiral SU(3) quark model by solving a resonating group method equation. The binding energy of this dibaryon is predicted to be around 100 MeV, the mean-square root of the distance between two Ω's is 0.84 fm, and the preliminary estimated mean lifetime is about two times that of the free Ω's. All these interesting properties, as well as the two negative charge units it carries, could make it easily identifiable experimentally in the heavy ion collision process. The production probability of this new dibaryon in a 158 GeV Pb+Pb collision is estimated using the thermal model. The rate is of the order of 10^{-6} to 10^{-5} per event. It is expected that, with the increase of the temperature, the production rate will also be increased.

PACS number(s): 24.85.+p, 13.75.Cs, 14.20.Pt, 25.75.Dw

Can we find the di- Ω

Since it was well established that, for free Ω, the most important decay modes are [22] ΛK^-, $\Xi^0\pi^-$, and $\Xi^-\pi^0$, now if the binding energy of about 100 MeV is taken into account, the decay channel $\Omega+\Lambda+K^-$ is forbidden strictly by energy conservation. And therefore only two decay channels remain, namely,

$$(\Omega\Omega)_{0^+}\rightarrow\Omega^-+\Xi^0+\pi^-$$

and

$$(\Omega\Omega)_{0^+}\rightarrow\Omega^-+\Xi^-+\pi^0.$$

Searching for Glueballs at STAR

Sam says "difficult"

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THE STATES ARE LISTED IN THE PARTICLE DATA GROUP MESON TABLES AS
f2(2010)  f2(2300),
f2(2340)
BUT THEY DO NOT CALL THEM GLUEBALLS.
ALL THREE HAVE, I=0, G=+, J=2, P=C=+.
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Want to look for "known" exotics

And see whether AuAu environment leads to enhanced relative production

Bump Hunting

Glueballs - Hybrids

Quantum numbers
Not in table

S. Godfrey and J. Napolitano: Light-meson spectroscopy

TABLE I. The quantum numbers and names of conventional $q\bar{q}$ mesons. (Note that η and η' are linear combinations of $n\bar{n}$ and $s\bar{s}$.)

		J^{PC}	$I=1$	$I=0$ $(n\bar{n})$	$I=0$ $s\bar{s}$	Strange
$L=0$	$S=0$	0^{-+}	π	η	η'	K
	$S=1$	1^{--}	ρ	ω	ϕ	K^*
$L=1$	$S=0$	1^{+-}	b_1	h	h'	K_1
	$S=1$	0^{++}	a_0	f_0	f_0'	$K_0^\star$
		1^{++}	a_1	f_1	f_1'	K_1
		2^{++}	a_2	f_2	f_2'	K_2^*
$L=2$	$S=0$	2^{-+}	π_2	η_2	η_2'	K_2
	$S=1$	1^{--}	ρ	ω	ϕ	K_1^*
		2^{--}	ρ_2	ω_2	ϕ_2	K_2
		3^{--}	ρ_3	ω_3	ϕ_3	K_3^*
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.

□□’

□ 547.3 Mev

□’ 958 MeV

Zhangbu says

“Check for Chiral symmetry restoration”

=> QGP??

Conclusions

May be able to trigger on some rare states

Best to gather >100M AuAu events and search

Need RHIC II and trigger/DAQ upgrades to record number of events required